

Contribution to the knowledge of the family Caecidae. 4. The temporary septum formation of some caecid species (Caenogastropoda: Rissooidea)

Contribución al conocimiento de la familia Caecidae. 4. La formación del septo temporal en algunas especies de Caecidae (Caenogastropoda: Rissooidea)

Mauro PIZZINI*, Marco OLIVERIO**, and Italo NOFRONI***

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ABSTRACT

Two successive septum formations are made by *Caecum dextroversum*, a species from the Panamic Province. The definitive septum is the second one and is hidden by the first temporary one until the latter is abraded and eliminated. The phenomenon is displayed by other species from the eastern Atlantic, viz. *C. clarkii*, *C. pollicare* and *C. sp.*

RESUMEN

Caecum dextroversum de la Provincia Panameña produce dos septos sucesivos: el primero es temporal, cupuliforme y cubre al segundo y definitivo, que es mucronado. Se sugiere que el septo temporal es una estructura preliminar para proteger al animal, hasta que el septo definitivo está completamente formado y que luego desaparece por erosión. La misma formación ha sido observada en otras especies del Atlántico oriental: *C. clarkii* (de las Islas Salvajes y Azores), *C. pollicare* (de las Islas Canarias) y *C. sp.* (de las Islas Azores).

KEY WORDS: *Caecum*, septum formation, *C. dextroversum*, western Pacific, *C. clarkii*, *C. pollicare*, eastern Atlantic.

PALABRAS CLAVE: *Caecum*, formación del septo, *C. dextroversum*, Pacífico occidental, *C. clarkii*, *C. pollicare*, Atlántico oriental.

INTRODUCTION

The septum is a formation used by many gastropods to close the shell once a part of it has been detached, or when the animal moves to an advanced position in the shell. Some archaeogastropods close

their limpet shell with a septum when the protoconch is thrown off. Apical whorls are lost by members of many caenogastropod genera (e.g. *Truncatella*, *Caducifer*, *Nassarius*), and of some heterobranch ones

* Largo della Caffarelletta 6. I-00179 Roma, Italia.

** Dipartimento Biologia Animale e dell'Uomo, "La Sapienza" Rome 1 University. Viale dell'Università 32. I-00185 Roma, Italia.

Present address: Dipartimento di Biologia, Rome 3 University. Viale G. Marconi 446, I-00146 Roma, Italia.

*** Via B. Croce 97, I-00141 Roma, Italia.

(e.g. *Rumina*), and the new openings are plugged by a septum formation (DRAPER, 1985). Members of the families Turritellidae and Vermetidae, produce septa at successive position in the shell, without breaking it.

In the meiobenthic family Caecidae, the septum is a feature shared by all species, with the exception of the *Parastrophia* group. In this family the morphology of the septum has long been considered a good diagnostic character at species level.

CARPENTER (1858-1859) classified the septa into three main groups: unguledated, mucronated and mamillated, apparently with no systematics in mind, since he classified the caecids into four genera based on the tube morphology only.

The formation of the septum and its relation to the different growth stages, was studied by DE FOLIN (1868-1869, 1875). His model assumed that the snail produced an incision in the internal side of the tube, at the level where the old (smaller) portion of the shell were to be detached. Meantime the animal positions below this level (the cutting plane) and prepares the septum adding the material concentrically, starting from the tube toward the centre.

In the NE Atlantic area some species show a remarkable variation in the septum morphology (i.e. *C. armoricum*: HOEKSEMA AND SEGERS, 1993; *C. clarkii* sensu AA., unpublished observations). Alleged ontogenetic variation in the septum morphology was reported by CARPENTER (1857) in the description of *C. dextroversum* from Western Mexico. He assumed that the dif-

ferences in the septum between juveniles and adults in the type series were due to changes in the shapes of the septum with the growth: "as the shell increases, the body of the plug swells out and becomes mamillated...especially as the central knob is apt to be rubbed off" (CARPENTER, 1857: 238).

During the study of the Caecidae of the Panamic Province that we are presently carrying out, we reviewed *C. dextroversum* and analysed this peculiarity. We give here an interpretation of the phenomenon that does not imply ontogenetic variation, but rather the formation of two successive septa. During the revision of the Caecidae of the NE Atlantic area, we have scored unquestionable rests of a temporary septum in some other species from this area: *C. clarkii* Carpenter, 1859 from Azores Islands and from Selvagem Islands, *C. pollicare* Carpenter, 1859 from Canary Islands and *C. sp.* from Azores Islands.

We take this occasion to give a preliminary account of the species so far involved in this study. They will be dealt with more extensively (especially as for their taxonomy) in the framework of the relevant geographic revisions, presently in preparation by the authors.

Abbreviations used:

MNHN: Museum Nationale d'Histoire Naturelle, Paris
NHML: Natural History Museum, London
spm(s): specimen(s), live collected

RESULTS

Superfamily RISSOIDEA Gray J. E., 1847

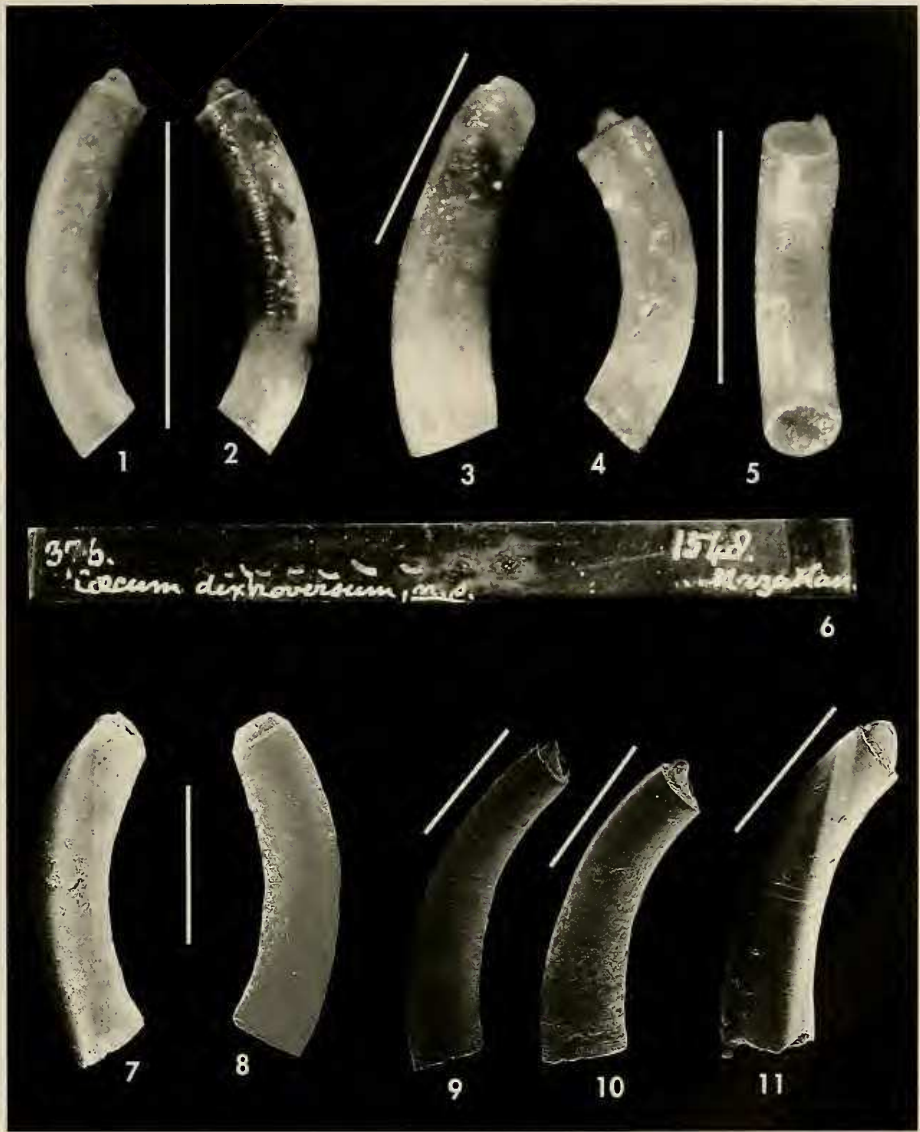
Family CAECIDAE Gray M. E., 1850

Genus *Caecum* Fleming, 1813

Caecum dextroversum Carpenter, 1857 (Figs. 1-8, 12-16)

Type locality: Mazatlán (Mexico), off Spondylus.

Type material: Type series, NHML no. 1857.6.4.1548 originally labelled: 7 shells at different growth stages glued on a glass marked with white ink by the Author (Fig. 6); 2 other shells detached from the same glass are stored in a gel-capsule: one is clearly a juvenile specimen, while the other is an adult perfectly fitting the description (see also BRANN, 1966: 63, fig. 1548), and is here selected as lectotype (Figs 1, 2).



Figures 1-8. *Caecum dextroversum*. 1, 2: Lectotype (NHML); 3-5: Paralectotypes (NHML); 6: Glass marked by Carpenter with seven paralectotypes (NHML no. 1857.6.4.1548); 7, 8: Punta la Gringa, Los Angeles Bay (Gulf of California). Figure 9: *Caecum* sp., Santa Maria Is. (Azores Islands), Ponta de Marvao, intertidal (MNHN). Figure 10: *Caecum pollicare*, Las Galletas, Tenerife Is. (Canary Islands), intertidal (MNHN). Figure 11: *Caecum clarkii*, Santa Maria Is. (Azores Islands), Ponta de Marvao, intertidal (MNHN). Scale bars, 1-5, 7, 8: 1 mm; 9-11: 500 μ m.

Figuras 1-8. Caecum dextroversum. 1, 2: Lectotipo (NHML); 3-5: Paralectotipos (NHML); 6: Cristal marcado por Carpenter con siete paralectotipos (NHML no. 1857.6.4.1548); 7, 8: Punta la Gringa, Bahía de Los Angeles (Golfo de California). Figura 9: Caecum sp., Santa Maria (Islas Azores), Ponta de Marvao, intermareal (MNHN). Figura 10: Caecum pollicare, Las Galletas, Tenerife (Islas Canarias), intermareal (MNHN). Figura 11: Caecum clarkii, Santa Maria (Islas Azores), Ponta de Marvao, intermareal (MNHN). Escalas, 1-5, 7, 8: 1 mm; 9-11: 500 μ m.

Material examined: The type material and: off Punta la Gringa, Los Angeles Bay (Gulf of California), -20/40 m (18 spms and 3 shells, P. and C. Skoglund *leg.*).

Original description: "376. *Caecum dextroversum*, n. s. C. (Fartulum) t. tereti, satis elongatâ, albâ, tenui, laevi: septo tumido, submammillato, mucrone tumidissimo, dextroversum lateraliter verso; aperturâ parum declivi, haud contracto; operculo vix concavo" (CARPENTER, 1857: 328).

Additional description: Shell small (length 1.7-2.4 mm, width 0.4-0.5 mm), white, with rounded simple aperture. Protoconch unknown. The temporary septum is submammillated, with a "small pimple" (HERTZ *ET AL.*, 1994) right oriented (Figs. 12-15). Septum more or less immersed with respect to the cutting plane, with a narrow dorsal mucro. Shell apparently smooth at low magnification with slightly undulated growth lines, but with a microsculpture visible at SEM of longitudinal striae (Fig. 16). Periostracum brown, with microsculpture of longitudinal striae.

Remarks: KEEN (1968) drew at the camera lucida two syntypes, indicated as the last and the last but one attached on the original glass slide: the shell of her fig. 92b is presently stored in the gel capsule, while the other (fig. 92b) seems to correspond to the sixth shell still glued on the slide.

Distribution: The species was described from Western Mexico (Mazatlán), and has been subsequently recorded from the north-eastern Baja California (HERTZ, 1979), South to the entire Panamic Province till Ecuador, and it is present also at Galapagos Islands (FINET, 1991). For a review on distributional data (with the relevant references) see SKOGLUND (1992) and SKOGLUND AND KOCH (1995) for the Panamic Province, and FINET (1994) for the Galapagos Islands.

Caecum clarkii Carpenter, 1859 (Figs. 11, 17)

Material examined: Selvagem Pequena Is. (Selvagem Islands) western coast, beached (1 shell and 12 spms, M. Segonzac *leg.*). Santa Maria Is. (Azores Islands), Ponta de Marvao, intertidal (9 shells and 92 spms, S. Gofas *leg.*). All material in MNHN.

Description: The shell is very thin and slender, vitreous in fresh specimens, without longitudinal microsculpture, but with wavy and irregularly set growth lines. Septum protruding, subtriangular from aside, with mucro more or less narrow. Aperture simple, with no varix. Periostracum tawny. Some specimens appears longitudinally striated when optically observed (probably due to refraction effects), but they prove smooth under SEM.

Remarks: We have scored unquestionable remains of the temporary septum in one specimen from Selvagem Islands

and in three adult and four juvenile specimens from Azores Islands. The population from Selvagem Islands is quite certainly conspecific with *C. clarkii* from Canary Islands (NOFRONI *ET AL.*, 1997). We have been unable to score any differences with the specimens from Azores, and we assign provisionally also these specimens to Carpenter's species.

Distribution: According to our data (NOFRONI, PIZZINI AND OLIVERIO, 1997) the typical *C. clarkii* is presently known from Canary Islands, Selvagem Islands and Azores Islands.

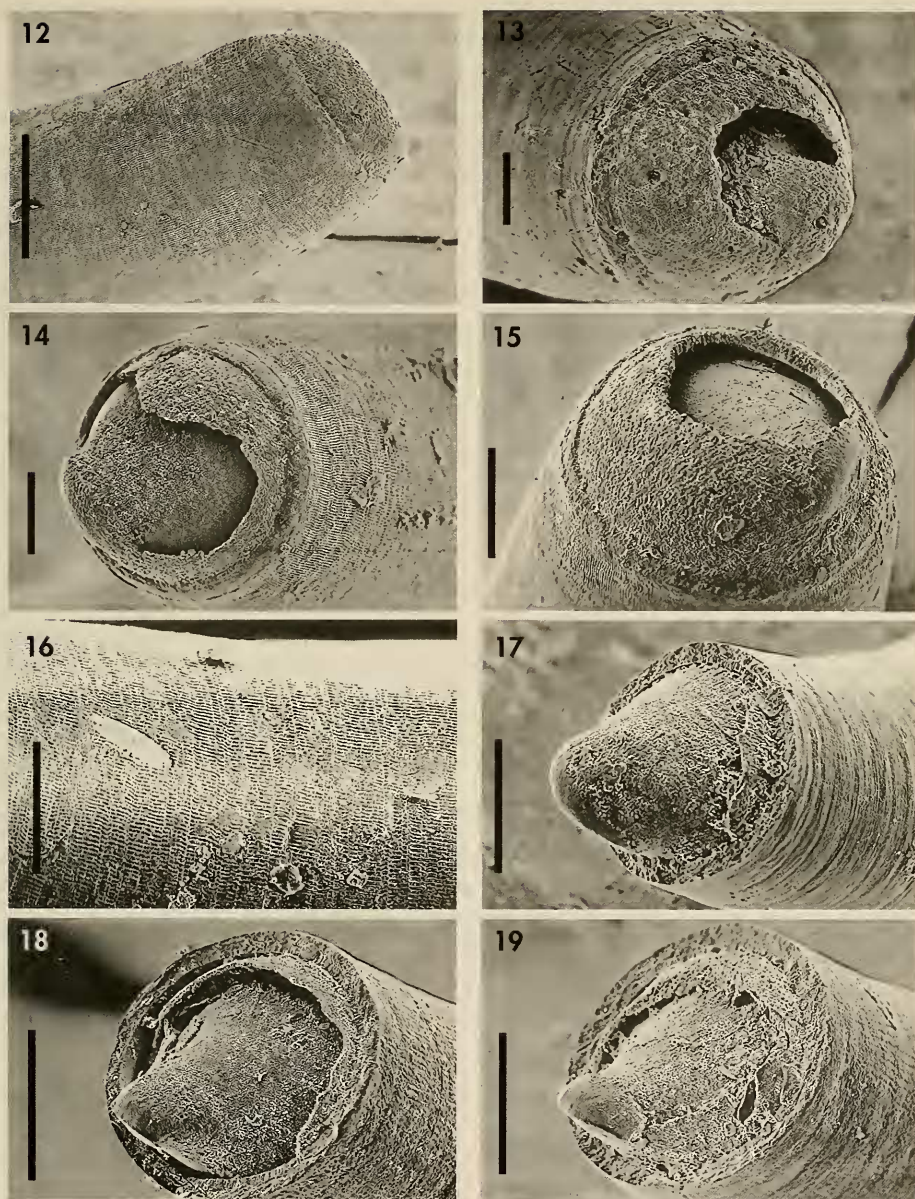
Caecum pollicare Carpenter, 1859 (Figs 10, 19)

Caecum clarkii sensu AA non Carpenter, 1859.

Caecum orientale sensu AA non de Folin, 1868, pars.

Caecum sardinianum sensu AA non de Folin, 1870.

Caecum semitrachea sensu AA non Monterosato, 1884 ex Brusina MS.



Figures 12-19. *Caecum* spp., details of temporary septum and microsculpture. Figures 12-16: *Caecum dextroversum*, Punta la Gringa, Los Angeles Bay (Gulf of California). Figure 17: *Caecum clarkii*, Santa Maria Is. (Azores Islands), Ponta de Marvao, intertidal (MNHN). Figure 18: *Caecum* sp., Santa Maria Is. (Azores Islands), Ponta de Marvao, intertidal (MNHN). Figure 19: *Caecum pollicare*, Las Galletas, Tenerife Is. (Canary Islands), intertidal (MNHN). Scale bars 100 μ m.

Figuras 12-19. Caecum spp., detalles del septo temporal y de la microescultura. Figuras 12-16: Caecum dextroversum, Punta la Gringa, Bahía de Los Angeles (Golfo de California). Figura 17: Caecum clarkii, Santa Maria (Islas Azores), Ponta de Marvao, intermareal (MNHN). Figura 18: Caecum sp., Santa Maria (Islas Azores), Ponta de Marvao, intermareal (MNHN). Figura 19: Caecum pollicare, Las Galletas, Tenerife (Islas Canarias), intermareal (MNHN). Escalas 100 μ m.

Type locality: Tenerife Is. (Canary Islands), 50 fms.

Type material: Type series. NHML no 1858.12.9.5: 6 shells glued on a glass labelled by the Author. Probable syntypes. NHML: 2 shells eroded not readable, labelled "Caecum pollicare Cpr 50 fms. Tenerife".

Material examined: The type material and several hundreds shells/spms from Canary Islands and Selvagem Islands (listed in NOFRONI ET AL., 1997); one spm. with temporary septum from Las Galletas, Tenerife Is. (Canary Islands), intertidal (P. Bouchet and S. Gofas leg.).

Description: See NOFRONI ET AL. (1997) for a detailed description. The "thumb-marks" longitudinal microsculpture is visible at low optical magnification (x40) and is characteristic of this species. Protoconch of 1.25 whorls with a strong lateral keel. Operculum thick, corneous, light brown. Internal side smooth if optically observed, with a single elicoid ridge; the external side has 5-7 concentric ridges.

Remarks: We have identified unquestionable remains of the temporary septum in one specimen from Tenerife Is. For the identification of this species with *Caecum pollicare* Carpenter, 1859 see NOFRONI ET AL. (1997).

Distribution: At present this species is known only from the islands of Tenerife, Lanzarote and La Palma (Canary Islands, Spain) and from Selvagens Islands (Portugal).

Caecum sp. (Figs. 9, 18)

Material examined: Santa Maria Is. (Azores Islands), Ponta de Marvao, intertidal (1 spm., S. Gofas leg.). São Miguel Is. (Azores Islands): -15/30 m (S. Gofas leg., 53 spms, 4 shells); intertidal (S. Gofas leg., 1 spm.); -24 m (BIACORES 1971, St. P36, 1 spm.); -13 m (S. Gofas leg. 1 spm.). All material in MNHN.

Description: Shell of small size (mean length 1.65 mm, mean width 0.4 mm), brownish with irregular whitish areas; microsculpture of longitudinal worm-like striae, recalling exactly the finger-printing, crossed by fine growth lines. Temporary septum presumably dome-shaped. Septum protruding a little from the cutting plane, with spatuliform mucro, slightly right oriented. Aperture simple. Operculum thick, corneous, light brown.

Remarks: We have identified unquestionable remains of the temporary septum in 9 juvenile and 4 adult speci-

mens from Azores Islands. They differ from *C. clarkii* in the septum morphology and the presence of an evident shell microsculpture. It is very closely related with *Caecum pollicare* Carpenter, 1859, with some differences in the microsculpture, the septum profile and the colour pattern: its taxonomic position is presently under study in the framework of the revision of the Azorean caecid fauna.

Distribution: We have so far examined specimens only from the Azores Islands.

DISCUSSION

CARPENTER (1857), in the description of *C. dextroversum*, assumed that the differences in the septum between juveniles and adults in the type series were due to ontogenetic changes in the shapes of the septum. The interpretation of the phenomenon that we propose here does not imply ontogenetic varia-

tion, but rather the formation of two successive septa: the first is dome-shaped, the second mucronated. The definitive septum is the second one and is hidden (at least partially) by the first (temporary) one until the latter is abraded and eliminated. This is witnessed by the figures 12-15, where interme-

diate stages in this phenomenon are pictured. Moreover, we can witness the occurrence of the temporary septum (or residuals of it) in juveniles of third stage. The erroneous interpretation by Carpenter have been probably due to the fact the nearly all juveniles he examined (as it appears in the type series) had only the second mucronated septum, while it was hidden by the temporary dome-shaped one in the few adults he had available.

As for the definition of the complete process of septum formation (related to the detachment of juvenile stages), and its biological implication, we remain with some possibilities. We assume that the temporary septum is made as a preliminary protection for the animal in case the preceding stage is detached before the definitive septum is formed. In fact the detachment of the preceding stage seems to occur at a point where an incision is present ("weakening groove" of DRAPER, 1985: 5). We suspect that this incision correspond, at least in some case, to the embasure observed at the aperture in many species. If this model is true, there is the possibility that the temporary septum is not exclusive to the species dealt with herein but rather is a phenomenon of much more common oc-

currence in the Caecidae. The dome-shaped formation may be rarely preserved due to its weakness (we have scored only remains of the temporary septum in the NE Atlantic species). Caecidae have been largely neglected, notwithstanding the large number of species included in the family, and this can explain how this phenomenon has been for so long overlooked. Furthermore, when only remains of the temporary septum are present only a careful examination allows them to be discerned. We are presently studying this topic, in order to verify our hypothesis. Furthermore, it is likely that this character contains some phylogenetic information, and a deeper insight can allow its integration in the systematic study of the family.

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BIBLIOGRAPHY

- BRANN, D. C., 1966. *Illustrations to "Catalogue of the Collection of Mazatlan Shells" by Philip P. Carpenter*. Paleontological Research Institute, Ithaca, New York. 111 pp., 56 pls.
- CARPENTER, P. P., 1857. *Catalogue of the collection of Mazatlan shells in the British Museum*. [Reprinted 1867] Paleontological Research Institute, 552 pp.
- CARPENTER, P. P., 1858-1859. First steps towards a monograph of the Family Caecidae, a family of Rostriferous Gasteropoda. *Proceedings of the Zoological Society of London*, 1858: 413-444 (413-432 [1858]; 433-444 [1859]).
- DRAPER, C. B., 1985. Mollusks which truncate their shells and how they plug the openings. *The Festivus*, 27: 3-9
- FINET, Y., 1991. Marine molluscs of the Galapagos Islands. In M. James (ed.): *Galapagos marine invertebrates*, Plenum Press, New York, 474 pp.
- FINET, Y., 1994. *The marine mollusks of the Galapagos Islands: a documented faunal list*. Editions Muséum d'Histoire Naturelle, Genève, 180 pp.
- DE FOLIN, L., 1868-1869. Observations on the septum of the Caecidae; and some remarks on the subject of the suppression of the Genera *Brochina* and *Streblloceras* or *Phleloceras*. *Journal of the Linnean Society (Zoology)*, 10: 254-264.
- DE FOLIN, L., 1875. *Monographie de la famille des Caecidae*. Bayonne. 31 pp.
- HERTZ, J., 1979. Minute shells. *The Festivus*, 11 (4): 32-34.
- HERTZ, C. M., MYERS, B. W. AND GEMMELL, J., 1994. The Caecidae of San Felipe and environs, Gulf of California, from the Gemmell collection (1965-1976). *The Festivus*, 26: 89-94.

- HOEKSEMA, D. S. AND SEGERS, W., 1993. On the systematics and distribution of the marine gastropod *Caecum armoricum* De Folin, 1869 (Prosobranchia, Caecidae). *Gloria Maris*, 31: 79-88.
- KEEN, A. M., 1968. West American mollusk types at the British Museum (Natural History). IV. Carpenter's Mazatlan collection. *The Veliger*, 10 (4): 389-439.
- NOFRONI, I., PIZZINI, M. AND OLIVERIO, M., 1997. Contribution to the knowledge of the family Caecidae. 3. Revision of the Caecidae of Canary Islands (Caenogastropoda: Rissooidea). *Argonauta*, 10 (7-12): 3-32.
- SKOGLUND, C., 1992. Additions to the Panamic province gastropod (Mollusca) literature - 1971 to 1992. *The Festivus*, 24 (Suppl.): viii + 166 pp.
- SKOGLUND, C., AND KOCH, R., 1995. New distributional information for Panamic province Rissooidea (Mollusca: Gastropoda). *The Festivus*, 27 (2): 23-28.